LOUDSPEAKER UNIT ADAPTED TO ENVIRONMENT

BACKGROUND OF THE INVENTION

1. Field of the Invention:

The present invention relates to a loudspeaker unit for improving the regenerative tone quality, more particularly to a loudspeaker unit particularly adapted to environment.

2. Description of the Related Art:

A loudspeaker unit of this type has, as disclosed in J.P.A. Gazette 130608/1989, had a reference signal source for comparative correction to be made in correcting frequency characteristics.

Fig. 1 is a structural view showing an example of a conventional loudspeaker unit of a regenerative sound feed back type having a reference signal source to be used for comparative correction. For amplifying sound source 101 with a desired frequency characteristic, switch 103 of the loudspeaker unit is switched to a fixed contact B side, and a level of a sound signal emitted from reference signal source 102 picked up by microphone 107 at a listening point is analyzed to perform a particular procedure for previously setting a gain of each element of graphic equalizer 104.

However, the loudspeaker unit with a corrected frequency characteristic has a problem such that its

frequency characteristic must be corrected by the reference signal every time the installation environment of the loudspeaker unit changes.

Fn s0'> Further, with the loudspeaker unit of which only the correction of the frequency characteristic is executed, there is a problem that no correction can be made to a sound lag and a phase shift to be caused by the reverberation and an echo of a sound.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a loudspeaker unit adapted to the environment and requires no particular procedure for correction of the acoustic characteristic thereof even if the installation environment of the loudspeaker unit changes.

Another object of the present invention is to provide a loudspeaker unit which can correct, in addition to the frequency characteristic of the sound, a sound lag and a phase shift ascribable to the reverberation and the echo of the sound.

Fn s 0²> The loudspeaker unit of the present invention adapted to the environment comprises a microphone for picking up a sound regenerated from a loudspeaker; processing means for comparing at real time an output signal from the microphone with an output signal from a

sound source with reference to the characteristic at an optional frequency and the characteristic of the reverberation as well as the echo each including the delay time, respectively, and correcting a signal from a sound source with the difference output signal between the microphone and the sound source; an amplifier for amplifying the output of the processing means; and a loudspeaker unit.

Also in the present invention, it is allowable to correct a signal to be sent to the loudspeaker by the result learned through arithmetic. It is acceptable to intermittently renew the parameter to correct the signal to be sent to the loudspeaker by using the result of the comparison.

In the present invention, since the sound characteristic is corrected depending on the regenerative sound source, the correction of the frequency characteristic of the regenerative sound based on the reference signal can advantageously be omitted even if the installation environment of the loudspeaker unit changes.

Further, since the sound picked up by the microphone is compared with the sound from the sound source with reference to the frequency characteristic, the reverberation and the echo characteristic, the invention can effectively correct the reverberation of

the sound, the echo delay and the phase shift.

In other words, according to the present invention, the loudspeaker unit can save a reference signal generator to be used for comparison and a switch for selecting this signal.

Further, since the processing module of the loudspeaker unit catches a feedback signal at real time, the particular procedure is not needed for the correction.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a structural view showing an example of a conventional loudspeaker unit of a regenerative sound feed back type having a reference signal source for use for comparative correction.

Fig. 2 is a structural view showing an embodiment of a loudspeaker unit adapted to the environment of the present invention.

Fig. 3 is a structural view showing a concrete embodiment of a loudspeaker unit adapted to the environment of the present invention.

Fig. 4 is a structural view showing another embodiment of a loudspeaker unit adapted to the environment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Next, an embodiment of the present invention will

be described in detail with reference to the drawings.

With reference to Fig. 2, there is provided loudspeaker unit 1 adapted to the environment comprising microphone 6 for picking up a sound issued from the loudspeaker 5, processor module 3 for receiving feedback signal 9 and sound source signal 7, and amplifier 4 for producing the sound from loudspeaker 5.

Next, the motion of Fig. 2 will be described with reference to the drawing.

Sound source signal 7 of sound source 2 to be desirably regenerated is inputted to processor module 3 before it is inputted to amplifier 4. Processor module 3 compares feedback signal 9 inputted from microphone 6 with sound source signal 7. Processor module 3 operates correction data so that feedback signal 9 may come most close to sound source signal 7 for the sake of obtaining a reasonable sound intensity characteristic or the desirable effect of echo suppression, and by applying thus obtained result to inputted sound source signal 7, produces correction signal 8 to send to amplifier 4. Amplifier 4 amplifies correction signal 8 to produce the sound from loudspeaker 5. Since this sound has been corrected at real time with reference to the frequency characteristic or the reverberation characteristic

affected by the property of the installation place of the loudspeaker unit, correction signal 8 approaches sound source signal 7.

Next, a concrete embodiment of the present invention will be described in detail referring to the drawings. With reference to Fig. 3, sound source 2 is a sounder such as a radio tuner, a compact disk or a sound chip of a personal computer. Processor module 3 comprises 16 bit A/D converter 31, 16 bit A/D converter 32, digital signal processor 35, 16 bit D/A converter 33, and memory 34. Amplifier 4 is an operational amplifier. It drives ~~the operational amplifier for driving~~ loudspeaker 5 of 57 mm in diameter with impedance of 8 Ω. Microphone 6 is composed of an electret condenser microphone of 9.5 mm in diameter with a flat frequency characteristic and a microphone amplifier. A cable which transmits feedback signal 9 outputted from microphone 6 is selected from a group of the noise-resistant shielding wire.

Next, the motion of the embodiment of the present invention will be described in detail with reference to Fig. 3.

Signal 7 from sound source 2 is converted to a digital signal by A/D converter 31 of processor module 3 and stored in memory 34. The data of all signals A/D converted within a fixed time stipulated for the

reverberation and the echo are stored as the data of sound source 2 in memory 34. On the other hand, a signal processed as a regenerative signal by digital signal processor 35 of processor module 3 is further converted to an analog signal by means of D/A converter 33, and after amplified by amplifier 4, it is sent forth from loudspeaker 5 as a sound. Microphone 6 picks up this sound, then the sound is converted as feedback signal 9 to a digital signal by A/D converter 32 and inputted to digital signal processor 35. Successive comparison analysis part 37 of digital signal processor 35 compares the data of sound source 2 stored in memory 34 with the digital data from successive A/D converter 32, analyzes the intensity of the reverberation and the echo, corrects the conversion data stored in memory 34 and gets a correction parameter. Regenerative signal processing part 36 adds the correction parameter to the conversion data of sound source 2 and processes the digital data to regenerate as a regenerative signal. The difference between the data of sound source 2 and the data of feedback signal 9 is obtained as the correction parameter in serial data and the parameter is processed by adding feedback signal 9 of an opposite phase, if necessary, to obtain a fixed number or 0. The processed signal is converted to an analog signal by

D/A converter 33, amplified by amplifier 4 and then sent forth from loudspeaker 5 as the sound.

The intensity of the reverberation and the change of the frequency characteristic are corrected according to the result learned about the data of sound source 2. After clearly grasping the frequency characteristic and the delay of the reverberation as well as the echo, the value set for correction is changed to determine the correction parameter.

Next, a second embodiment of the present invention will be described referring to the drawings.

With reference to Fig. 4, in order to decrease the load of processor module 3, data processing for the correction purpose is not to be performed at real time, but a correction parameter previously extracted from the past example is better used intermittently, and thus it becomes possible to correct the sound delay and the phase shift which may be caused by the reverberation and the echo.

Further, by attaching microphone 6 to a casing of loudspeaker unit 1 of the present invention, the wiring to be laid outwardly from the casing can be omitted.